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INSTRUCTION MANUAL

FOR

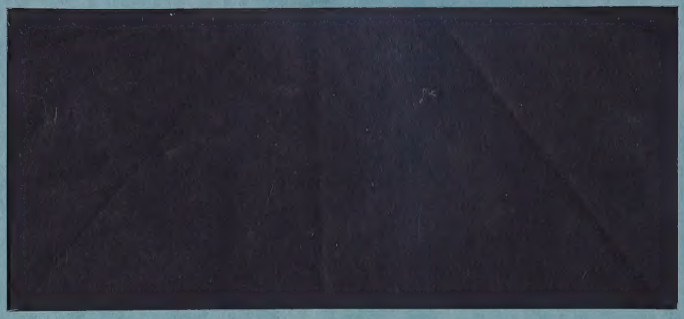
HIGH-VOLTAGE POWER SUPPLY

MODEL 133

(Model 133S
S/N 2131)

ELECTRONIC INSTRUMENTATION FOR INDUSTRY

CALIBRATION STANDARDS CORPORATION *a subsidiary of* ROYAL INDUSTRIES, INC.



HIGH-VOLTAGE POWER SUPPLY

MODEL 133

(Model 133S
S/N 2131)

SERIAL 149

CALIBRATION STANDARDS CORPORATION

ALHAMBRA, CALIFORNIA

CUmberland 3-8156

TWX - 213-288-5492

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SPECIFICATIONS

Model	Polarity	Output (kv)	Output (ma)	Regulation	Stability
133	Reversible	0-6	0-20	.01% or 10mv	.005%/hour .03%/day

INPUT: 117 VAC, 50-60 cps

REGULATION: Specified for ±10% line change from 117 VAC or a load change of 20 ma

STABILITY: Specified after 30-minute warmup

ACCURACY: 0.25% of voltage dialed or 1V, whichever is greater

RIPPLE: Less than 5 mv RMS

RESOLUTION: 10 mv, any output voltage

VOLTAGE CALIBRATION:
5-1000V steps
9-10V steps
9-100V steps
1-0 to 10V vernier

OUTPUT CONNECTOR: Amphenol MS3102A-18-16S on front and rear panels

SIZE: 7"H x 19"W x 15"D

SHIPPING WEIGHT: 54 pounds

SECTION I

OPERATING INSTRUCTIONS

1.1 When installing this power supply, place it in an area with adequate ventilation, as overheating will shorten the life of the components.

1.2 Place the Power and HV switches in the OFF position, and connect the three-wire line-cord to a proper receptacle supplying 105-125 volts at 50-60 cycles.

1.3 Set the polarity switch to the desired output polarity. Note carefully the nomenclature on the panel. "+Gnd" means that the grounded shell of the output connectors will be positive, and the center high voltage terminal will be negative. The output polarity should not be changed while the high voltage is turned on.

1.4 Couple the load to the HV output, using the connector provided and a shielded high voltage cable capable of withstanding the maximum output voltage of this supply, plus a safety factor. The shield braid of the cable will serve as the grounded conductor for the output, and protect the operator and adjacent equipment from the high voltage.

1.5 Turn on the Power Switch. The "PWR" pilot lamp should light. A two-minute time delay will be initiated at this time. This delay is provided to prevent the high voltage from being activated until the tubes are properly warmed up.

1.6 Set the front panel dials to the voltage to be used, and operate the "HV" switch. The "HV ON" indicator will light, and the voltage set on the front panel dials will be available at the output connectors.

1.7 While the instrument is turned on, the operator may change voltages at will without worrying about overshoot in the regulator.

SECTION II

GENERAL DESCRIPTION

2.1 The Calibration Standards Corporation's Model 133 Precision Power Supply is capable of outputs from zero to 6000V, and zero to 20 ma, and is designed for bench use or rack mounting. The stability of the output voltage is 0.005% per hour, after a reasonable warmup time, and 0.03% per day.

2.2 Calibration of the front panel dials is in five steps of 1000V each, nine steps of 100V each, nine steps of 10V each, and one 0-10V continuously adjustable vernier calibrated at .1V intervals (6000V is read as 5-9-9-10V). Accuracy of the front panel dial calibration is better than 0.25%, or 1V, whichever is greater.

2.3 The output voltage is monitored by a 6-0-6kv meter, calibrated in 200V steps. Resolution is such that the output voltage, when measured by an external differential voltmeter, such as the CSC Model DC-100A, DC-110A, or DC-200A, and a 1000:1 precision divider, may be set to within 10 mv of any desired voltage from zero to 6000V.

2.4 Voltage regulation for a 20% change in line voltage (105-130V), or a 20 ma change in load current is 0.01%, or 10 mv, whichever is greater. Ripple and jitter are less than 5 mv RMS at any output voltage and current in either polarity. Output polarity may be plus or minus, with respect to chassis, and may be selected by a front panel switch. The output connectors for the HV are Amphenol MS3102A-18-16S. One is mounted on the front panel, and one on the rear panel. The mating connector furnished is Amphenol MS3106A-18-16P.

2.5 The input voltage to the Model 133 is 117V at 50-60 cps. During standby, the power supply draws 120 watts and, under full load, 280 watts. The size of this instrument is 19" x 7" x 15", and the net weight is 42 pounds.

SECTION III

CIRCUIT DESCRIPTION

3.1 There are two filament supplies, three regulated dc auxiliary supplies and a regulated high voltage supply in this instrument. One filament supply provides 6.3V at 5.5A unregulated, and the other provides 6.3V at 0.6A regulated for tubes V4 and V7. This filament supply is regulated by means of a series current regulator tube, V12, an Amperite Type 9-7.

3.2 The regulated dc auxiliary supplies are fed by a common voltage doubler supply consisting of CR1 to CR6, and C1 to C4. This supply provides about 900V, and is center-tapped to give +450V to the regulator circuits for the +300V supply and the +105V supply, and -450V to the regulator circuit of the -300V supply.

3.3 The +300V supply consists of V6, V7, V8, V9, and V13. V8 and V9 provide a stable reference voltage for V7, which operates as a differential amplifier to produce an amplified error voltage whenever the output voltage deviates from the required value. This error voltage is then applied to V6b, amplified, and fed into V6a, the series passing element. V6a then restores the output voltage to its proper value. V13 provides a moderate amount of regulation for the plate supply voltage of V6b. This supply provides a stable 300V source for the two reference tubes, V8 and V9. The stable output voltage from these reference tubes is then applied to the series string resistors in the voltage control network for the main HV supply.

3.4 The -300V supply consists of dropping resistor R17 and voltage regulator tubes V1 and V2. This regulated voltage supplies the operating potential to the control amplifier in the high voltage regulator section.

3.5 The screen supply for the series pass tube consists of a series dropping resistor, R18, and a type OB2 regulator tube, V10. The raw dc supply for this and the +300V supply is common to both. Since the cathode of the series pass tube is always at 0V potential, with respect to the common buss of the auxiliary supplies, this arrangement is allowable.

CIRCUIT DESCRIPTION (Continued)

3.6 The high voltage supply starts with an unregulated high dc voltage supplied by CR101 to CR136, and C101 to C124 in a voltage doubler circuit which provides up to 9000V. This high voltage is then applied to the series passing tube, V11. Grid control voltage for the series passing tube is provided by a two-stage control amplifier. This two-stage, dc-coupled amplifier consists of a differential error amplifier, V4, and a driver stage, V3, for the series passing tube.

3.7 The differential amplifier has two inputs. One is from the zero voltage reference (the +HV line), and the other is from the junction of R75 and the four-decade rheostat. These two inputs are normally at the same potential but, when a change in load or a change in line voltage causes the output voltage to change from the desired value, a potential difference occurs between these two inputs. This potential difference is the error voltage, and this error voltage is amplified by the control amplifier to a level sufficient to control the series passing tube. The series passing tube then raises or lowers the output voltage enough to restore it to the desired value.

3.8 The highly stable reference voltage from V8 and V9 is effectively in series with the output of the high voltage supply. Resistors R29 (the CAL ADJUST control), and R30 are in series with the four-decade rheostat. During the calibration process, the current flowing through this series string of resistors is established at 1 ma. Since the rheostat is designed on a 1000-ohm per volt basis, the resistance of the rheostat times the 1 ma current flowing through it equals the high voltage output. For any setting of the four decade rheostat, a certain error voltage will be produced in the differential amplifier, amplified, and applied to the series passing tube. This tube, acting as a big resistor, will then adjust its resistance to increase or decrease the voltage drop across it and establish the output voltage at the desired value.

3.9 In order to prevent damage to the series passing tube from excessive plate dissipation, the x1000V front panel control also provides switching in the primary of the high voltage supply transformer when changing the output in 1000V steps.

SECTION IV

CALIBRATION

4.1 The equipment needed to calibrate this precision power supply is as follows: a differential voltmeter, CSC Models DC-100A, DC-110A, DC-200A or equivalent, and a voltage divider, CSC Model HV-10 or equivalent. Use only a well-insulated screwdriver in making adjustments.

4.2 With no load on the output, and the polarity switch turned to "GND", turn the instrument on and let it warm up. The voltage control dials should be adjusted for 6000V output, to aid in warming the instrument.

4.3 After about a thirty-minute warmup period, set the front panel voltage controls for zero volts output. Connect a sensitive voltmeter to the output connector. Remove the top cover and adjust R45, the ZERO ADJUST control, for zero output voltage, as indicated on the sensitive voltmeter. Disconnect the voltmeter.

4.4 Couple the precision 1000:1 ratio voltage divider to the output connector and the differential voltmeter to the output of the divider.

CAUTION: Do not make any connections to the output with the high voltage turned on.

4.5 Set the front panel controls for 6000V (5-9-9-10) output, and adjust R29, the CAL ADJUST control, to give exactly 6.000V at the output of the voltage divider.

4.6 Adjust R65, the METER CAL control, to set the front panel meter indication to -6kv. Turn the high voltage off and disconnect the voltage divider. The instrument is now calibrated.

SECTION V

MAINTENANCE

5.1 WARNING: Lethal voltages are present in this instrument. Be sure to discharge the high voltage capacitors before working inside the instrument. The metal shell of some of the electrolytic capacitors may be as high as 9500V potential with respect to chassis ground.

5.2 The only routine maintenance required for this instrument is a periodic cleaning to remove the dust collected by electrostatic attraction. If not kept clean, the high voltage insulation will no longer be effective, and arcing or leakage may occur.

5.3 The use of conservatively rated components in this instrument should provide long, trouble-free service. Aging should improve the stability of the power supply. Tube replacement should not be a problem with this instrument. However, a small percentage of replacement tubes for V3, V4, and V7 will be found to cause pool line voltage regulation, due to filament voltage variation. A twenty-four hour, or more, run-in time would be desirable before final recalibration, if tubes V3, V4, V7, V8, or V9 were to be replaced.

5.4 In the event of failure, first give the instrument a thorough visual inspection. If an obvious fault is not found, the use of a VTVM, the schematic diagram, the component location diagram, and the circuit description should be sufficient to repair the instrument. Voltage measurements should be made with reference to 0 volts or ground, with the polarity switch turned to the "+GND" position. Use extreme caution when making any measurements in this instrument.

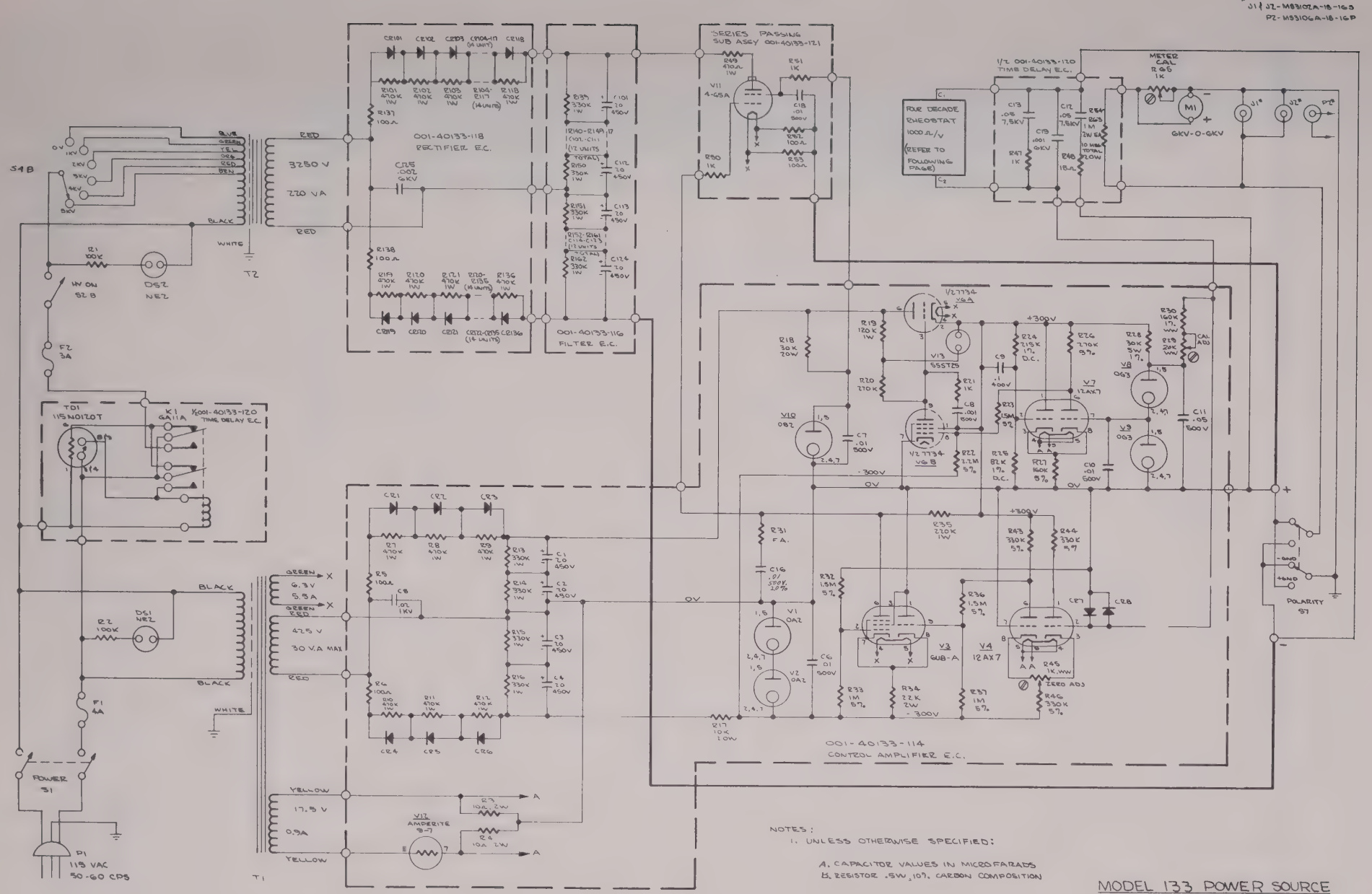
5.5 At the end of the manual is a list of replaceable parts. When a component is found to be faulty, refer to the list. If desired, replacement parts may be ordered through the Factory, or through the service personnel. Refer to all parts by their stock number, and be sure to indicate the instrument serial number in any correspondence.

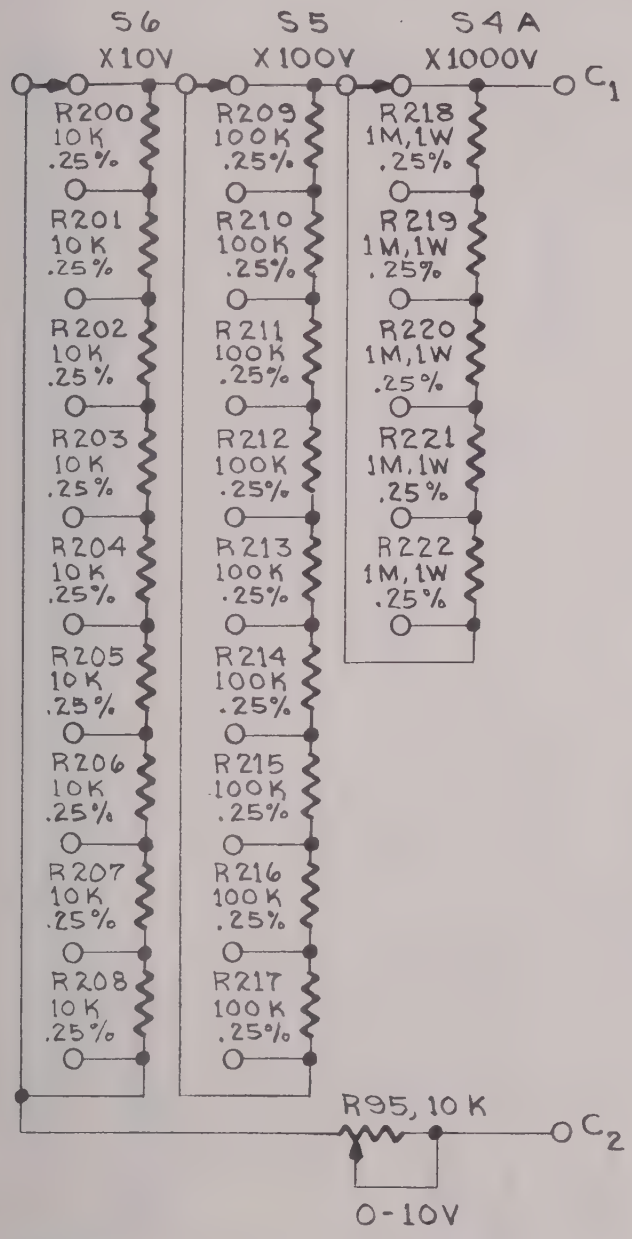
WARRANTY

CALIBRATION STANDARDS CORPORATION warrants each instrument to be free from defects in material and workmanship. Materials not covered by this warranty are fuses and tubes. The instrument must be returned to the factory with shipping prepaid and a complete report of the difficulty. This warranty is good for one year from the shipping date.

SHIPPING DAMAGE

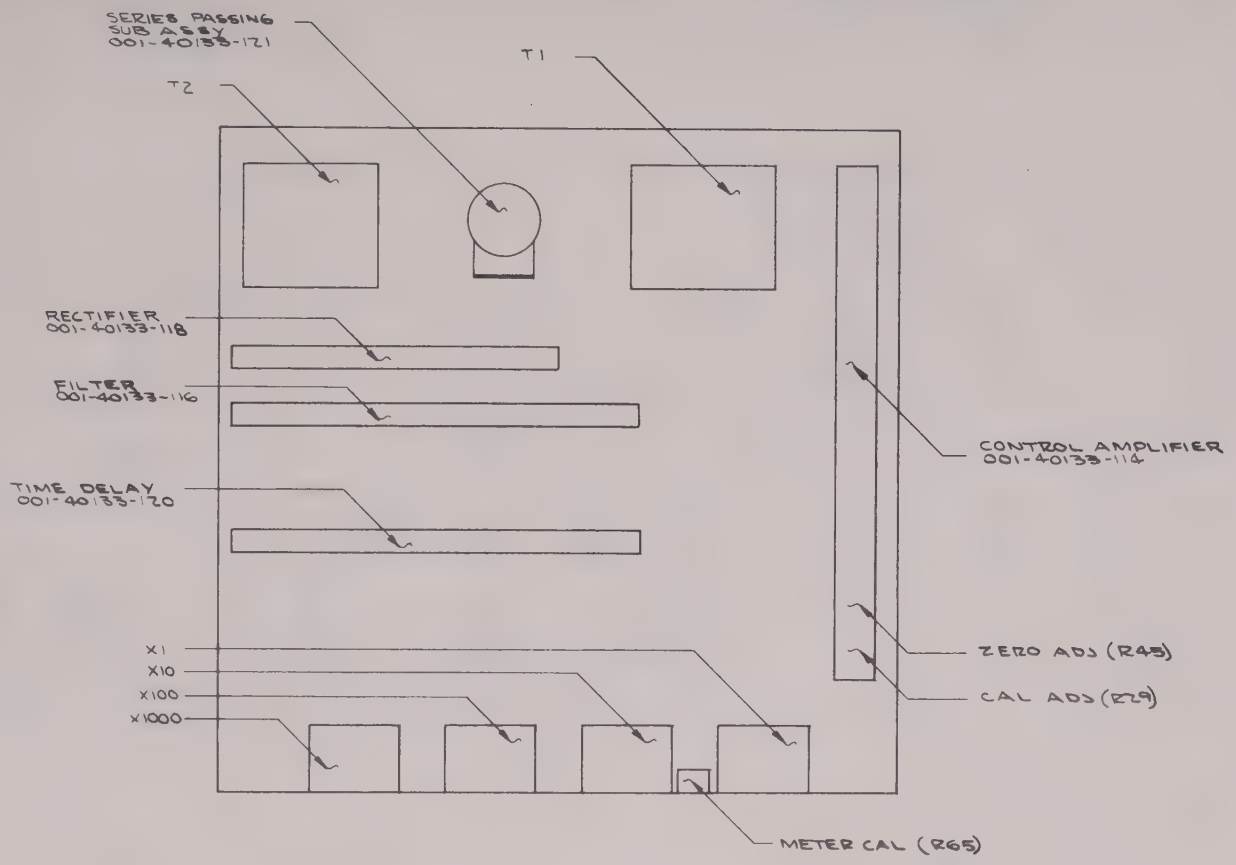
If there is any damage to the instrument upon receipt, report this to the transportation Claim Agent immediately.


J1 & J2 - MS3102A-18-1S
P2 - MS3106A-18-1SP
S1B
TRANSFORMER T2
3250 V
220 VA
RECTIFIER E.C.
001-40133-118
FILTER E.C.
001-40133-116
SERIES PASSING SUB ASSY 001-40133-121
TIME DELAY E.C.
001-40133-120
FOUR DECADE RHEOSTAT 1000Ω/V
METER CAL R95 1K
GKV-0-GKV
CONTROL AMPLIFIER E.C.
001-40133-114
TRANSFORMER T1
6.3V 5.5A
425 V
30 V.A MAX
17.5 V
0.9A
AMPERITE 8J7
ZERO ADJ
POLARITY S7
POWER S1
P1 115 VAC 50-60 CPS
NOTES:
1. UNLESS OTHERWISE SPECIFIED:
A. CAPACITOR VALUES IN MICROFARADS
B. RESISTOR .5W, 10% CARBON COMPOSITION
MODEL 133 POWER SOURCE

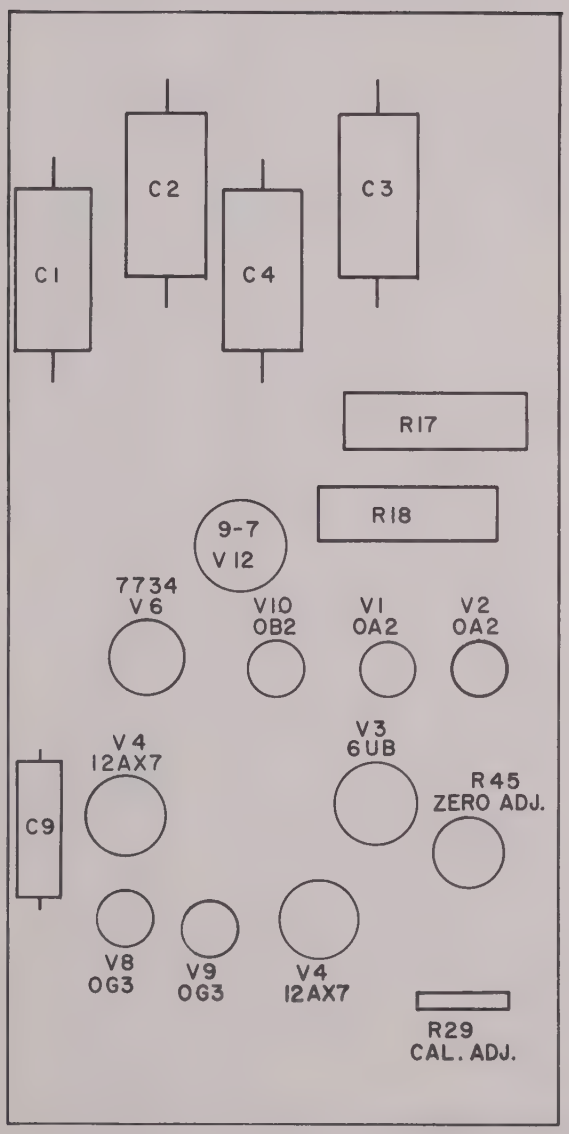


FOUR DECADE RHEOSTAT
1000 Ω/V

REV.	DWG NO	DRAWN
	001-10133-003 SH3	LA BEUR-2-5-62
	APPV: R L M	DATE: 2-6-62



LOCATION DWG MODEL 133



CALIBRATION CONTROL AND TUBE LOCATION

CONTROL AMPLIFIER CARD 001-40 133-114

REPLACEABLE PARTS

Quantity or Circuit Description	Description	Stock Number
Control Amplifier Sub-Assembly, 001-40133-114		
2	Bracket - EC Mounting	170-00000-248
CR1 through CR8	Diode Rectifier	130-02000-019
R7 through R12	Resistor, 470K, 1W, 10%, Comp	100-01052-474
R13 through R16	Resistor, 330K, 1W, 10%, Comp	100-01052-334
C1 through C4	Capacitor, Electrolytic, 20uf, 450V	113-02000-020
C5	Capacitor, Disc, .02uf, 1400V	110-01541-203
C6, C7, C10	Capacitor, Disc, .01uf, 500V	110-01281-103
R17	Resistor, 10K, 20W, 10%, WW	100-03132-103
R5, R6	Resistor, 100-ohm, .5W, 10%, Comp	100-01042-101
R31	Resistor, 10K, .5W, 10%, Comp	100-01042-103
R22	Resistor, 2.2 Meg, .5W, 5%, Comp	100-01043-225
R33, R37	Resistor, 1 Meg, .5W, 5%, Comp	100-01043-105
R23, R32, R36	Resistor, 1.5 Meg, .5W, 5%, Comp	100-01043-155
R43, R44, R46	Resistor, 330K, .5W, 5%, Comp	100-01043-334
R26	Resistor, 270K, .5W, 5%, Comp	100-01043-274
R27	Resistor, 160K, .5W, 5%, Comp	100-01043-164
R20	Resistor, 270K, .5W, 10%, Comp	100-01042-274
R21	Resistor, 1K, .5W, 10%, Comp	100-01042-102
R24	Resistor, 215K, .5W, 1%, Carbon	100-02044-2153
R25	Resistor, 82K, .5W, 1%, Carbon	100-02044-8202
R28	Resistor, 30K, 5W, 1%, WW	100-03044-3002
R30	Resistor, 160K, .5W,.1%, WW	100-07045-1603
R18	Resistor, 30K, 20W, 10%, WW	100-03132-303
R34	Resistor, 22K, 2W, 10%, Comp	100-01062-223
R35	Resistor, 220K, 1W, 10%, Comp	100-01052-224
R45	Pot, 1K, 1.5W, 20%, WW	106-01301-102
R3, R4	Resistor, 10-ohm, 2W, 10%, Comp	100-01062-100
C8	Capacitor, Ceramic Disc, .001, 500V, +20%, -80%	110-01292-102
C9	Capacitor, .1uf, 400V, 20%, Mylar	110-03251-104
V13	Neon Regulator	142-04000-005
C11	Capacitor, .05uf, 500V, +20%, -80%, Ceramic Disc	110-01281-503
C16	Capacitor, .01uf, 500V, 20%, Ceramic Disc	110-01281-103
5	Socket, Tube, 7-pin Min PC	120-02000-016
4	Socket, Tube, 9-pin Min PC	120-03000-017
1	Socket, Tube, 8-pin Min PC	120-05000-020
R19	Resistor, 120K, 1W, 10%, Comp	100-01052-124
R29	Pot, 20K, .5W, 10%, WW	106-01042-203

REPLACEABLE PARTS (Continued)

Quantity or Circuit Description	Description	Stock Number
Filter Board Sub-Assembly, 001-40133-116		
C101 through C124	Capacitor, 20uf, 450V, Electrolytic	113-02000-042
R139 through R162	Resistor, 330K, 1W, 10%, Comp	100-01052-334
2	Bracket, EC Mtg	170-00000-248
Rectifier Board Sub-Assembly, 001-40133-118		
R101 through R136	Resistor, 470K, 1W, 10%, Comp	100-01052-474
CR101 through CR136	Diode-Rectifier	130-02000-019
2	Bracket, EC Mtg	170-00000-248
R137, R138	Resistor, 100-ohm, .5W, 10%, Comp	100-01042-101
C125	Capacitor, Ceramic Disc, +20%, -80%, .002 at 6kv	110-01411-202
R49	Resistor, 470-ohm, 1W, 10%, Comp	100-01052-471
1	Plate Cap Connector	170-00000-209
Time Delay Board Sub-Assembly, 001-40133-120		
TD1	Relay, Thermal Time Delay	180-00000-006
K1	Relay, 115V	180-00000-002
C12, C13	Capacitor, .05uf, 7.5kv, ±20%	110-11432-503
R48	Resistor, 15-ohm, .5W, 10%, Comp	100-01042-150
R47	Resistor, 1K, .5W, 10%, Comp	100-01042-102
R218 through R222	Resistor, 1 Meg, 1W, .25%, WW	100-03056-1004
R54 through R63	Resistor, 1 Meg, 2W, 10%, Comp	100-01062-105
1	Bracket, EC Mtg	170-00000-248
1	Bracket, EC Mtg	170-00000-249
1	Tube Socket, 9-pin	120-03000-017
1	Wire Tube Clip	170-00000-237
4	Bracket Modification	900-00133-133
Series Passing Sub-Assembly, 001-40133-121		
1	Terminal Strip, 7-pin	170-00000-250
1	Tube Socket, 7-pin	120-07000-021
R50, R51	Resistor, 1K, .5W, ±10%, Comp	100-01042-102
R52, R53	Resistor, 100-ohm, .5W, ±10%, Comp	100-01042-101
C18	Capacitor, .01uf, 500V, ±20%, Ceramic Disc	110-01281-103

REPLACEABLE PARTS (Continued)

Quantity or Circuit Description	Description	Stock Number
Miscellaneous		
S4	Switch, 2-pole, 6-position	160-01000-064
S7	Switch, 2-pole, 2-position	160-01000-065
T1	Auxiliary Transformer	150-00000-026
T2	Main Transformer	150-00000-027
V1, V2	Tube, OA2	135-05000-006
V8, V9	Tube, OG3	135-05000-030
V10	Tube, OB2	135-05000-016
V11	Tube, 4-65A	135-03000-033
V12	Tube, 9-7	135-06000-034
V4, V7	Tube, 12AX7	135-07000-021
V6	Tube, 7734	135-07000-029
V3	Tube, 6U8A	135-07000-035
R65	Pot, 1K, 1.5W, 20%, WW	106-01301-102
2	Receptacle, HV, Chassis	185-05000-015
1	Line Cord, 3-wire	170-00000-003
R95	Pot, 10K, 7W, 5%, WW	106-01103-103
R209 through R217	Resistor, 100K, .17W, .25%, WW	100-07316-1003
R200 through R208	Resistor, 10K, .17W, .25%, WW	100-07316-1002
S1, S2	Switch, DPST	160-01000-030
DS1, DS2	Light Assembly, Pilot	170-00000-138
R1, R2	Resistor, 100K, .5W, 10%, Comp	100-01042-104
M1	Meter, 500-0-500 Microamp	155-04000-010
F1	Fuse, 4A	140-01000-006
F2	Fuse, 3A	140-01000-001
S5, S6	Switch Modification	900-00133-131
4	Rubber Foot	170-00000-010

precision instruments

CALIBRATION STANDARDS CORPORATION

CSC's outstanding ACCURACY and STABILITY result from...

ULTRA STABLE ZENER REFERENCE

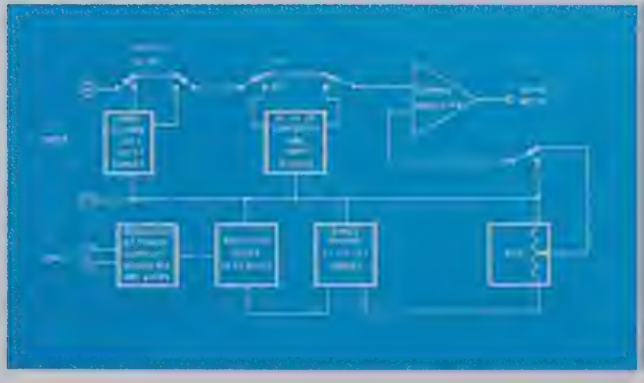
All Calibration Standards Corporation's precision voltmeters incorporate an ultra stable, temperature compensated Zener reference. The Zener reference is not adversely affected by shock, vibration, wide temperature excursions, operating position, or short circuiting. CSC, through its pioneering efforts in this field, has achieved typical yearly reference stability of ±0.001% (10 ppm) and temperature stability of ±0.0002% (2 ppm)/°C from 15°C to 40°C. References of this high caliber are utilized in the 200 series instruments.

PRECISION WIRE WOUND RESISTORS

All precision wire wound resistors are aged and tested in Calibration Standards Corporation's resistance laboratory. The resistors used in the 200 series instruments are oil filled and have long term stability better than 0.002%/year. Temperature stability is better than ±2.5 ppm/°C over a wide temperature range. These resistors are used as voltage dividers in the instruments. Therefore, the ratio stability is of prime importance and is maintained at better than 5 ppm over a year's time.

SILICON SEMICONDUCTORS

All Calibration Standards Corporation's instruments and power supplies use silicon transistors and diodes. The superior reliability and performance of these components add to the many advantages of Calibration Standards Corporation's equipment.

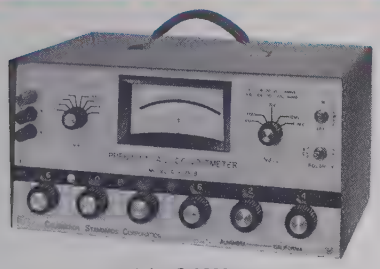


TYPICAL VOLTMETER CIRCUIT

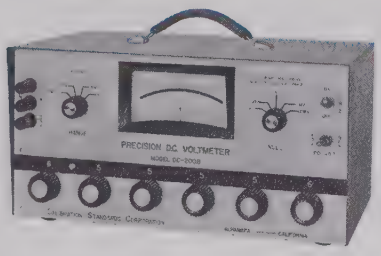
FEATURES OF ALL CSC VOLTMETERS

Continuously Self-Calibrating (60 times per second) • Ultra-Stable Zener References (Series 200 Instruments, 0.001%/year, 0.001% for 10% line change, 2PPM/°C; Series 100 Instruments, 0.01%/year, 0.005% for 10% line change, 5PPM/°C; Series 110 Instruments, 0.005%/year, 0.005% for 10% line change, 3PPM/°C • Precision selected and aged wire-wound resistors with stability of 0.001%/year (Series 200) and 0.005%/year (Series 100) • No Zero Controls necessary • No Calibration Controls necessary • Lightweight, Compact, Portable • All Transistorized • Low Power consumption • All Accuracies stated are of reading, not full scale • Measurement Ranges of 0 to 1000 volts DC and .001 to1000 volts AC • 6 digit readout for Series 200 Instruments, 5 digit readout for Series 100 Instruments • Most sensitive Null range is ±1 millivolt for AC and DC measurements • All instruments calibrated by Primary Standards with traceability to the Bureau of Standards • Certificates supplied upon request • All instruments available in cabinet and rack models • Recorder output to facilitate long term strip chart recording • Operation is the same for both AC and DC measurements • Ultra-Stable Kelvin-Varley Divider • Infinite Input Impedance • Differential Input •

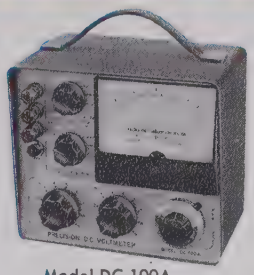
PRECISION ELECTRONIC INSTRUMENTS FOR INDUSTRY



Model AC-200B

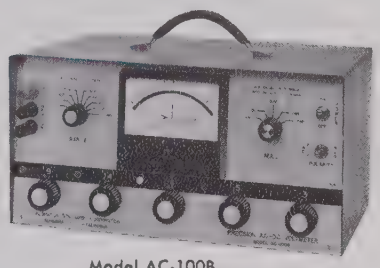


Model DC200B



Model DC-100A

Model DC-150BR



Model AC-100B

VOLTMETER SPECIFICATIONS

Model	DC-100A	AC-200B	DC-110B	AC-110B	DC-150B	AC-200B	DC-200B	AC-200B
Accuracy (of reading) DC	±.05% ±5 microvolts	±.05% ±5 microvolts	±.02% ±5 microvolts	±.02% ±5 microvolts	±.01% ±5 microvolts	±.01% ±5 microvolts	±.0075% ± 5 microvolts***	±.0075% ±5 microvolts***
Accuracy (of reading) AC		.2% .5-1000 VAC 30 cps-10KC		±.1% .5-1000 VAC 50 cps-5KC ±.15% .5-1000 VAC 30 cps-10KC		±.1% .5-1000 VAC 50 cps-5KC ±.15% .5-1000 VAC 30 cps-10KC		±.1% .5-1000 VAC 50 cps-5KC ±.15% .5-1000 VAC 30 cps-10KC
Input Voltage Range, AC & DC	0-1000 volts DC .1, 1, 10, 100, 1000 volts DC	0-1000 volts AC & DC .1, 1, 10, 100, 1000 volts DC; 10, 100, 1000 volts AC	0-1000 volts DC .1, 1, 10, 100, 1000 volts DC	0-1000 volts AC & DC .1, 1, 10, 100. 1000 volts DC; 10, 100, 1000 volts AC	0-1000 volts DC .1, 1, 10, 100, 1000 volts DC	0-1000 volts AC & DC .1, 1, 10, 100, 1000 volts DC; 10, 100, 1000 volts AC	0-1000 volts DC 1, 10, 100, 1000 volts DC	0-1000 volts AC & DC 1, 10, 100. 1000 volts DC; 10, 100, 1000 volts AC
Null Ranges, AC & DC	.001, .01, .1, 1, 10, 100 volts DC	.001, .01, .1, 1, 10, 100 volts AV & DC,	.001, .01, .1, 1, 10, 100 volts DC	.001, .01, .1, 1, 10, 100 volts AC & DC;	.001, .01, .1, 1, 10, 100 volts DC	.001, .01, .1, 1, 10, 100 volts AC & DC	.001, .01, .1, 1, 10, 100 volts DC	.001, .01, .1, 1, 10, 100 volts AC & DC,
Kelvin Varley Divider Accuracy (of reading) 1/10 scale to full scale	±.01%	±.01%	±.0075%	±.0075%	±0.0025%	±0.0025%	±.002%	±.002%
Number of Readout Digits	5	5	5	5	5	5	6	6
TVM Accuracy	±4% FS DC	±4% FS AC & DC	±4% FS DC	±4% FS AC & DC	±4% FS DC	±4% FS AC and DC	±4% FS DC	±4% FS AC and DC
Line Stability of Reference % /10% change	±.005%	±.005%	±.002%	±.002%	±.001%	±.001%	±.001%	±.001%
Temperature Stability of Zener Element	±5 ppm/°C 15°C to 40°C	±5 ppm/°C 15°C to 40°C	±5 ppm/°C 15°C to 40°C	±5 ppm/°C 15°C to 40°C	±3 ppm/°C 15°C to 40°C	±3 ppm/°C 15°C to 40°C	±2 ppm/°C 15°C to 40°C	±2 ppm/°C 15°C to 40°C
Temperature Stability of Total Instrument (Resistors & Zener)	±10 ppm/°C 10°C to 40°C	±10 ppm/°C 10°C to 40°C	±10 ppm/°C 10°C to 40°C	±10 ppm/°C 10°C to 40°C	±7 ppm/°C 10°C to 40°C	±7 ppm/°C 10°C to 40°C	±5 ppm/°C 10°C to 40°C	±5 ppm/°C 10°C to 40°C
Yearly Stability of Zener Reference	±20 ppm typical ±50 ppm max	±20 ppm typical ±50 ppm max	±20 ppm typical ±40 ppm max	±20 ppm typical ±40 ppm max	±10 ppm typical ±20 ppm max	±10 ppm typical ±20 ppm max	±10 ppm typical ±20 ppm max	±10 ppm typical ±20 ppm max
Yearly Stability of Range and Kelvin Varley Resistors	50 ppm Range 20 ppm KVD	50 ppm Range 20 ppm KVD	50 ppm Range 20 ppm KVD	50 ppm Range 20 ppm KVD	20 ppm Range* 20 ppm KVD	20 ppm Range* 20 ppm KVD	20 ppm Range* 5 ppm KVD*	20 ppm Range* 5 ppm KVD*
Input Resistance at Null DC	Infinite 0-10 VDC 2 megohms 10V to 1KV	Infinite 0-10 VDC 2 megohms 10V to 1KV	Infinite 0-10 VDC 2 megohms 10V to 1KV	Infinite 0-10 VDC 2 megohms 10V to 1KV	Infinite 0-10 VDC 2 megohms 10V to 1KV	Infinite 0-10 VDC 2 megohms 10V to 1KV	Infinite 0-10 VDC 2 megohms 10V to 1KV	Infinite 0-10 VDC 2 megohms 10V to 1KV
Input Impedance AC		1 meg +25 uuf 0-100 volts AC 2 meg +25 uuf 100-1000 VAC		1 meg +25 uuf 0-100 volts AC 2 meg +25 uuf 100-1000 VAC		1 meg +25 uuf 0-100 volts AC 2 meg +25 uuf 100-1000 VAC		1 meg +25 uuf 0-100 volts AC 2 meg +25 uuf 100-1000 VAC
Warmup	10 minutes	10 minutes	15 minutes	15 minutes	30 minutes	30 minutes	30 minutes	30 minutes
Input Power	117 VAC, 50-60 cps, 3 watts	117 VAC, 50-60 cps, 8 watts	117 VAC, 50-60 cps, 5 watts	117 VAC, 50-60 cps, 8 watts	117 VAC, 50-60 cps, 5 watts	117 VAC, 50-60 cps, 8 watts	117 VAC, 50-60 cps, 5 watts	117 VAC, 50-60 cps, 8 watts
Shipping Weight	10 pounds	13 pounds	11 pounds	13 pounds	11 pounds	13 pounds	12 pounds	14 pounds
Size: Cabinet	7″ h x 8″ w x 6″ d	7¼″ h x 14½″ w x 8½″ d	7¼″ h x 14½″ w x 8½″ d	7¼″ h x 14½″ w x 8½″ d	7¼″ h x 14½″ w x 8½″ d	7¼″ h x 14½″ w x 8½″ d	7¼″ h x 14½″ w x 8½″ d	7¼″ h x 14½″ w x 8½″ d
Rack	7″ h x 19″ w x 6″ d	7″ h x 19″ w x 8½″ d	7″ h x 19″ w x 8½″ d	7″ h x 19″ w x 8½″ d	7″ h x 19″ w x 8½″ d	7″ h x 19″ w x 8½″ d	7″ h x 19″ w x 8½″ d	7″ h x 19″ w x 8½″ d
Price: Cabinet	$475.00	$855.00	$575.00	$1040.00	$775.00	$1225.00	$965.00	$1425.00
f.o.b. Alhambra, Calif. Rack	$495.00	$875.00	$595.00	$1060.00	$795.00	$1245.00	$985.00	$1445.00
Meter			Taut Band	Taut Band	Taut Band	Taut Band	Taut Band	Taut Band

*Special Oil Filled Precision Resistors

**220-volt, 50-60 cps operation at $10.00 additional cost
117-volt, 400 cps operation at $60.00 additional cost on DC-100A, standard on all "B" models

†All "B" series instruments have inline readout with decimal lights and polarity switch

***Available with DC accuracy of .005% at increased prices listed ..... $1480.00 ..... $1970.00 .....

AC/DC CONVERTERS

Designed and engineered to extend the operation of existing DC Precision Voltmeters and DC Digital Voltmeters to have AC measuring capabilities, CSC's AC/DC CONVERTERS are used also in electronic systems where an AC signal must be converted to DC prior to control, computing or measuring.

Voltage Ranges: .5–10, 10–100, and 100–1000 VAC.

Frequency Range: 30 cps to 10 KC.

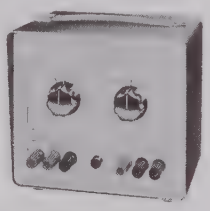
Voltage Accuracy: Model C-100A & AR: 0.15% absolute from .5 to 1000 VAC.

Input Impedance: 10 volt range—1 megohm and 20 micro-microfarads • 100 volt range—1 megohm and 20 micro-microfarads • 1000 volt range—2 megohms and 20 micro-microfarads.

Output: 0 to 10 volts DC into 10 megohms or infinite load.

Input Voltage: 115 volts AC, 50/60 cps.

Price: Model C-100A: $535.00.
Model C-100AR: $555.00.



C-100A

PRECISION VOLTAGE REFERENCE

The only completely solid-state Precision Voltage Reference accurate to ±0.005%, CSC's Model PVR-1A features a 6 digit dial out from any standard cell voltage from 1.01000 VDC to 1.02000 VDC.

Accuracy: ±0.005% at 25°C.

Output Impedance: 5000 ohms per volt.

Line Regulation: 0.001% (10 PPM) for 10% line voltage change.

Readout Linearity: 0.002% (20 PPM).

Stability: 0.002% (20 PPM) and 0.004% (40 PPM) per year typical for complete instrument.

Temperature Stability: 0.005% (5 PPM) per °C from +10°C to +40°C.

Input Voltage: 115 VAC, 50/60 cps—2 watts.

Output Terminals: Dual set—one providing 1.00000 VDC, the second providing adjustable voltage from 1.01000 to 1.02000 VDC.

Price: Model PVR-1A: $375.00.
Model PVR-1AR: $395.00.

PVR-1A

DC VOLT-AMP METER

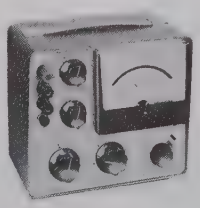
The compact, potentiometric Precision DC Volt-Amp Meter, Model VA-100A, measures 0 to 1,000 volts DC with Accuracy of ±0.05% + 5 microvolts absolute and Current from 1 microampere to 1 ampere with Accuracy of ±0.1% and ±0.2% absolute. All Specifications same as DC-100A but include current measuring feature.

Current Accuracy:

0 to .1 ampere: ±0.1% of reading, 1/2 scale to full scale; ±0.2% of reading, 1/10 scale to 1/2 scale; 0.2% +0.001 microampere below 1 microampere.

.1 to 1 ampere: ±0.2% of reading, 1/2 scale to full scale; ±0.3% of reading, 1/10 scale to 1/2 scale.

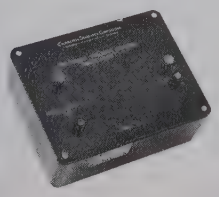
Price: Model VA-100A: $625.00.
Model VA-100AR: $645.00.



VA-100A

HIGH VOLTAGE DIVIDERS

	HV-10	HV-30
Range:	1000–10,000 VDC.	1000–30,000 VDC.
Ratio:	1000:1—10,000 volts input = 10 volts output.	30,000:9—30,000 volts input = 9 volts output.
Accuracy:	0.01% over a temperature range of 22.5°C to 27.5°C. 0.015% over a temperature range of 20°C to 30°C.	0.01% over a temperature range of 20°C to 30°C. Self-heating temperature must be taken into account.
Stability:	0.01%/year (ratio adjustable inside cabinet).	0.005%/year.
Input Resistance:	100 megohms.	60 megohms.
Size:	5¼" x 6¾" x 2 7/16"	5" diameter, 21" length including insulator.
Price:	$250.00.	$850.00.



HV-10A

HV-30

COMBINATION GALVANOMETER, POWER SUPPLY AND WHEATSTONE BRIDGES

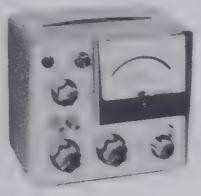
CSC's unique 3 in 1 combination with absolute accuracies to ±0.025 +0.003 ohm offers users an ultra-sensitive Wheatstone Bridge, all transistorized chopper readout amplifier and a bridge voltage power supply in a single, compact, lightweight and portable instrument for laboratory and production line test.

Accuracy: WB-110A and AR:
±0.025% + 0.003 ohm absolute.
WB-100A and AR:
±0.05% + 0.005 ohm absolute.

Range: 1 ohm to 100 megohms in 8 ranges.

Sensitivity: 1 mv for full scale. Chopper Amplifier. Variable front panel Bridge Voltage Control.

Price: WB-100A: $575.00.
WB-100AR: $595.00.
WB-110A: $685.00.
WB-110AR: $705.00.



WB-100A WB-110A

REGULATION MONITORS

Designed specifically to measure the stability of any DC voltage from 2.0 to 5,000 volts, CSC's three Regulation Monitors read out directly in percent deviation. Drift is less than 0.005% for an 8 hour day with short term drift less than 0.002%. At maximum sensitivity, the meter shows a full scale deflection for a deviation of ±0.1%.

Sensitivity: .1%, 1%, 10% full scale.

Voltage Range: RM-2A: 2–500 VDC.
RM-2A-3: 2–3000 VDC.
RM-2A-5: 2–5000 VDC.

Input Resistance: 7000 ohms per volt or greater.

Stability: ±0.005% for a 10% line change.

Temperature Stability: ±0.005%/°C from 10–40°C.

Price: RM-2A: $390.00. RM-2AR: $410.00.
RM-2A-3: $485.00. RM-2AR-3: $505.00.
RM-2A-5: $595.00. RM-2AR-5: $615.00

RM-2A

LABORATORY and PRODUCTION FACILITIES

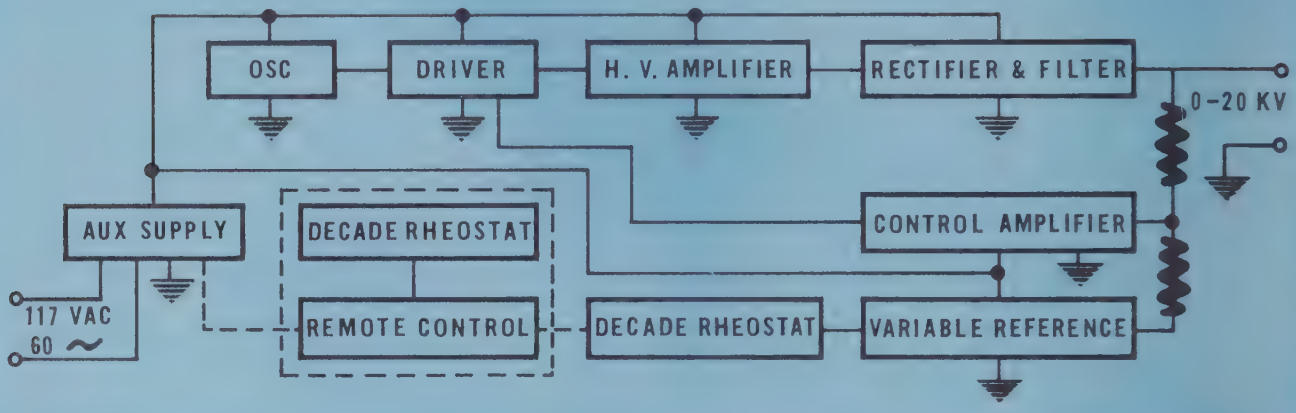
CSC's laboratory and production facilities are among the most modern in the industry. To insure reliable operation of completed instruments, each component is thoroughly inspected and tested in Receiving. During each major step in production, CSC Precision Voltmeters and Power Supplies undergo rigid inspections and tests by Quality Assurance Specialists. This continuing program assures users of receiving quality instruments, ready for immediate application.

All instruments are calibrated in a temperature controlled area using calibration standards of 5 to 10 times more accuracy than the rated accuracy of the instrument being calibrated. All primary standards are traceable to the National Bureau of Standards. Certification of our instruments is available upon request at no charge. Each 150 series and 200 series instrument is tested in an environmental chamber over a temperature range of 10°C to 40°C to assure the customer of greatest accuracy over the total operating temperature range of the instrument. Calibration Standards Corporation has operated its voltmeters over a temperature range of −20°C to +100°C without impairing the operation of the instruments.

SOLID STATE CIRCUITRY

The Calibration Standards Corporation line of precision power supplies incorporates solid state circuitry in the amplifier and reference sections of the supply. The addition of this new circuitry has improved the line and load regulation, ripple, and stability, and provides faster warmup and greater stability. Since there are no amplifier or reference tubes, transformer size and weight have been reduced.

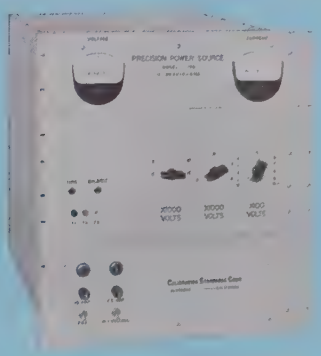
MODEL 170 BLOCK DIAGRAM



PRECISION
20 KV HIGH VOLTAGE SOURCE
MODEL 170

Calibration Standards' 20 KV High Voltage Precision Power Source, Model 170, is the outgrowth of over two years study and research of high voltage DC generation techniques. An entirely new high voltage design concept was developed due to the limited components available.

Basically, the system follows the principle of generating a low frequency a.c. signal applied through an intermediate driver stage to a conventional linear amplifier. The amplifier provides approximately 10,000 VAC from its special high Q tank circuit to a conventional high voltage rectifier-doubler and filter circuit which produces an output of slightly more than 20,000 volts of unregulated d.c. This 20 kv of d.c. is applied across a precision resistance string. At a precise lower level on the string, a d.c. potential is compared to a well regulated variable reference source of d.c. The error signal from the comparison amplifier is then applied to the screen of the driver (at a low level) which in turn controls the high voltage output amplifier stages.



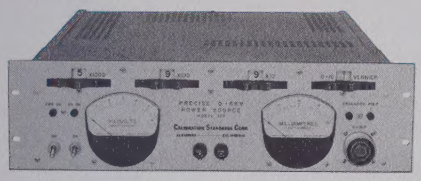
The Model 170 has many interesting features, some of which are: that it may be taken to zero voltage output, has extremely low ripple, is self-protected from inadvertent overload, and may be remote programmed with more than one channel of control.

SPECIFICATIONS

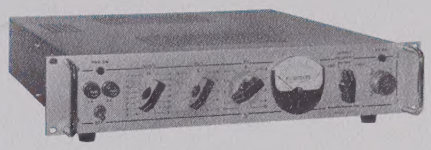
INPUT VOLTAGE:	105-130 VAC, 50/60 cps
OUTPUT VOLTAGE:	0-20,000 VDC
OUTPUT CURRENT:	0-5 ma
OUTPUT POLARITY:	Positive or negative (specify) (May be simply inverted)
STABILITY:	.02%/hr., .05%/day (Above 1 KV level)
REG. VS. LINE:	Better than .02% (Above 1 KV level)
REG. VS. LOAD:	Better than .02% (zero to full load) (Above 1 KV level)

RESOLUTION:	1V
ACCURACY:	.25% directly off controls
RIPPLE:	Less than 1V RMS
CONNECTORS:	(1) on rear (mating connector supplied)
SIZE:	19″ W x 21″ H x 18″ D
NET WEIGHT:	200 lbs.
SHIPPING WEIGHT:	230 lbs.

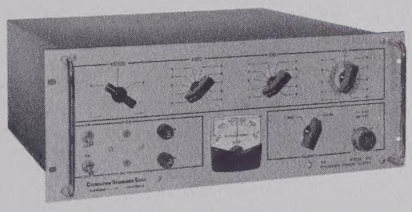
PRECISION ELECTRONIC INSTRUMENTS FOR INDUSTRY



Model 123

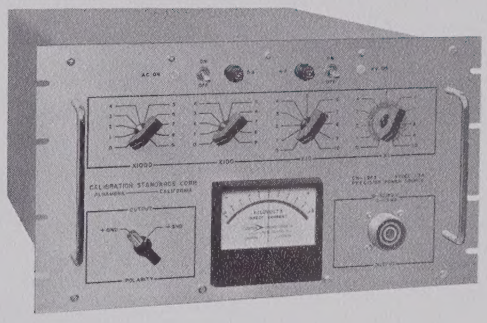


Model 120S



Model 132S

Model 127

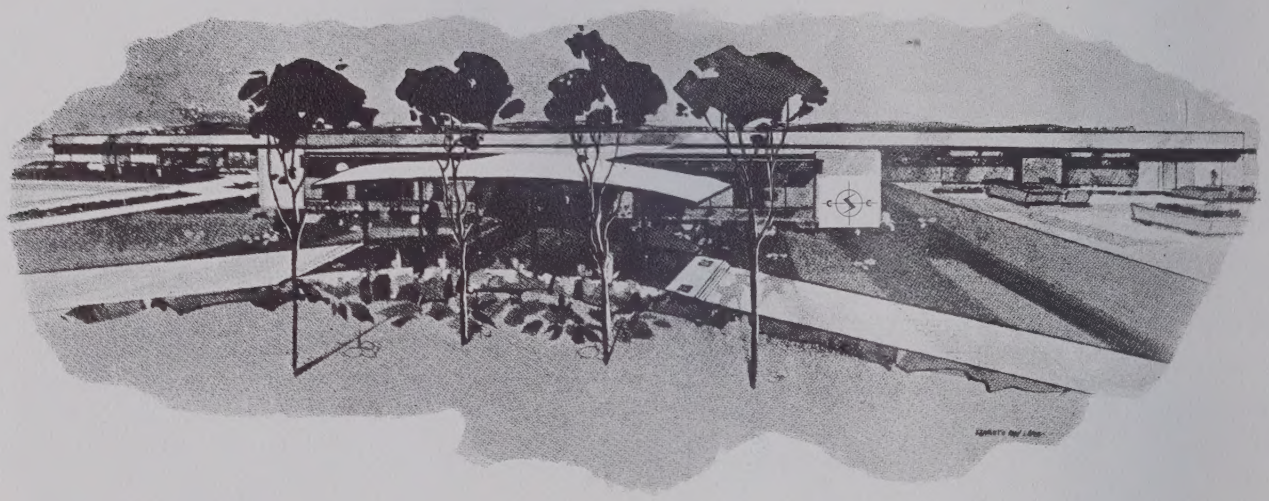


Model 134

POWER SUPPLY SPECIFICATIONS

Model	120 S	122B	123	127 P or N	132 S	133 S	134	170
Input Voltage*	105-130 VAC, 50-60 cps	105-130 VAC, 50-60 cps	105-130 VAC, 50-60 cps	105-130 VAC, 50-60 cps	105-130 VAC, 50-60 cps	105-130 VAC, 50-60 cps	105-130 VAC, 50-60 cps	105-130 VAC, 50-60 cps
Output Voltage	500-2210 VDC	0-3000 VDC	0-6000 VDC	500-3000 VDC	0-3000 VDC	0-6000 VDC	0-10010 VDC	0-20000 VDC
Output Current	0-20 ma	0-20 ma	0-20 ma	0-2 ma	0-20 ma	0-20 ma	0-15 ma	0-5 ma
Output Polarity	Positive or Negative	Positive or Negative	Positive or Negative	Positive or Negative	Pos or Neg, front panel switched	Pos or Neg, front panel switched	Pos or Neg, front panel switched	Positive or Negative
Stability	.005%/hour, .03%/day	.005%/hour, .03%/day	.005%/hour, .03%/day	.02%/hour	.005%/hour, .03%/day	.005%/hour, .03%/day	.005%/hour, .03%/day	.02%/hour, .05%/day
Regulation vs line	.002%	.002%	.005	.02	.002%	.002%	.002%	.02%
Regulation vs load	.002%	.002%	.005	.02	.002%	.002%	.002%	.02%
Resolution	10 mv	10 mv	10 mv	100 mv	10 mv	10 mv	10 mv	100 mv
Accuracy	.25%	.25%	.25%	.5%	.25%	.25%	.25%	.25%
Ripple	1 mv rms	1 mv rms	5 mv rms	5 mv rms	5 mv rms	5 mv rms	1 mv rms	1 volt rms
Metering	One 0-3KV	0-3KV	0-6KV, 0-20 ma	0-3KV	0-3KV	0-6KV	0-10KV	0-20000, 0-6 ma
Connectors	Front and rear, mating supplied	Front and rear, mating supplied	Front and rear, mating supplied	Front and rear, mating supplied	Front and rear, mating supplied	Front and rear, mating supplied	Front and rear, mating supplied	Rear, mating supplied
Size	3½" h x 19" w x 15" d	3½" h x 19" w x 18" d	5¼" h x 19" w x 18" d	5¼" h x 19" w x 16" d	7" h x 19" w x 15" d	7" h x 19" w x 15" d	10½" h x 19" w x 17" d	21" h x 19" w x 18" d
Net Weight	25 pounds	35 pounds	49 pounds	28 pounds	38 pounds	40 pounds	85 pounds	150 pounds
Shipping Weight	30 pounds	40 pounds	54 pounds	33 pounds	43 pounds	45 pounds	95 pounds	190 pounds
Price (fob Alhambra)	$410.00	$595.00	$895.00	$345.00	$575.00	$675.00	$990.00	$3250.00

All supplies utilize silicon transistors, amplifier, and Zener reference
*220 volt, 50-60 cps operation $10.00 additional cost (not available on 170)



The architect's rendering depicts the new quarters for Calibration Standards Corporation, scheduled for completion in 1964. The new CSC home office will incorporate one of the most complete standards laboratories in industry and will provide CSC with almost double its present production, engineering, research and testing facilities. The new, air-conditioned facility will be located in the City of Industry.

REPRESENTED BY

CALIBRATION STANDARDS CORPORATION

A subsidiary of ROYAL INDUSTRIES, INC.
1031 Westminster Avenue
Alhambra, California

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